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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

First Named Inventor : Tao Zhang et al.		Appeal No. --- #15 m 6-3-04
Appln. No. : 09/896,895		
Filed : June 29, 2001		Group Art Unit: 2651
For : REAL-TIME AUTOMATIC LOOP-SHAPING FOR A DISC DRIVE SERVO CONTROL SYSTEM		Examiner: Andrew Sniezek
Docket No.: S01.12-0787		

BRIEF FOR APPELLANT

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
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I HEREBY CERTIFY THAT THIS PAPER IS BEING SENT BY U.S. MAIL, FIRST CLASS, TO THE COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450, THIS 19th DAY OF MAY, 2004.

ARego
PATENT ATTORNEY

Sir:

This is an appeal from an Office Action dated December 23, 2003 in which claims 1-4, 9, 11-12, 15-20 and 25 were finally rejected and claims 5-8, 10, 13-14, 21-24 and 26 were objected to.

REAL PARTY IN INTEREST

Seagate Technology LLC, a corporation organized under the laws of the state of Delaware, and having offices at 920 Disc Drive, Scotts Valley, California 95066, has acquired the entire right, title and interest in and to the invention, the application, and any and all patents to be obtained therefor, as set forth in the Assignment filed with the patent application and recorded on Reel 012189, Frame 0673.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF THE CLAIMS

I. Total number of claims in the application.

	Claims in the application are:	1-26
II.	Status of all the claims.	
A.	Claims cancelled:	---
B.	Claims withdrawn but not cancelled:	---
C.	Claims pending:	1-26
D.	Claims objected to but allowable:	5-8, 10, 13-14, 21-24 and 26.
E.	Claims rejected:	1-4, 9, 11-12, 15-20 and 25.
III.	Claims on appeal	
	The claims on appeal are:	1-4, 9, 11-12, 15-20 and 25.

STATUS OF AMENDMENTS

No amendments were filed subsequent to the final rejection.

SUMMARY OF INVENTION

The present invention relates to real-time vibration control in a system that includes a servo loop. (Page 6, lines 11-12).

FIG. 1 of the present specification illustrates a disc storage system 100 that includes a servo loop. (Page 4, lines 13-14). Details of servo loop 300 are shown in FIG. 3. (Page 6, line 15).

Servo loop 300, which is utilized for positioning a head 110 over a disc 106 in disc drive 100, includes a voice coil motor actuator 216 that moves head 110 in response to a received servo control signal 215. A sensor, located in head 110, senses servo information located on disc 106 and produces a servo signal 206 therefrom. Servo signal 206 is combined with a reference signal 204 to produce a position error signal 208. A servo controller 210 receives the position error signal 208 and responsively produces servo control signal 215. Servo controller 210 includes a drive signal generator 212 that receives position error signal 208 and responsively produces a driving energy signal 213. A vibration

damping circuit 214 receives driving energy signal 213 and responsively produces the servo control signal 215. (Page 5, lines 7-18).

A real-time adaptive loop shaping circuit 302, included in servo loop 300, detects vibrations in position error signal 208 and responsively adjusts at least one parameter of a transfer function of vibration damping circuit 214 to reduce vibrations at different frequencies in driving energy signal 213. (Page 6, lines 19-24).

DESCRIPTION OF REFERENCES RELIED ON BY THE EXAMINER

Appellants' admitted prior art FIG. 2 shows a disc drive servo loop 200 that utilizes vibration damping circuit parameters that are set at the time of manufacture of the disc drive. Servo-loop 200 does not include a real-time adaptive loop shaping circuit capable of detecting vibration energy in a position error signal in real-time and responsively adjusting, in real-time, at least one parameter of a transfer function of the vibration damping circuit to reduce vibrations at different frequencies.

Ottesen et al. U.S. Patent No. 6,417,982, hereinafter "Ottesen" (See Appendix B), relates to a method and apparatus for identifying and filtering a resonance frequency of a support structure supporting a read/write head in proximity with a data storage medium. The vibration filtering scheme of Ottesen requires deactivation of all notch filters (step 202 of FIG. 6A) and a reduction of the spindle velocity (step 210 of FIG. 6A) for computation modules 120, 122 and 128, of vibration filtering system 100 (FIG. 5), to carry out necessary computations for vibration detection and reduction. New coefficients, produced as a result of these computations, are incorporated in notch filters 128 before they are subsequently re-activated for normal operation.

Sidman et al. U.S. Patent No. 5,155,422, hereinafter

"Sidman" (See Appendix B), relates to methods and apparatus for automatically identifying changes in overall gain of a mechanical plant and adjusting servo loop gain accordingly.

ISSUES

Whether claims 1-3, 9, 11, 12, 15-19 and 25 are non-obvious in view of the Appellants' admitted prior art (figure 2) and Ottesen.

Whether claims 4 and 20 are non-obvious in view of the Appellants' admitted prior art (figure 2), Ottesen and Sidman.

GROUPING OF CLAIMS

The following groupings of claims are made solely in the interest of consolidating issues and expediting this Appeal. No grouping of claims is intended to be nor should be interpreted as being any form of admission or a statement as to the scope or obviousness of any limitation.

Group I: Claims 1-4, 9, 11, 12 and 15;

Group II: Claims 16-20 and 25.

ARGUMENT

I. Rejection of Group I claims

In the final Office Action, the Examiner rejected claims 1-3, 9, 11, 12 and 15 under 35 U.S.C. §103(a) as being unpatentable over Appellants' admitted prior art (figure 2) in view of Ottensen. Further, claim 4 was rejected under 35 U.S.C. §103(a) as being unpatentable over Appellants' admitted prior art (figure 2) and Ottensen, and further in view of Sidman.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined)

must teach or suggest all of the claim limitations. In re Vaeck, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. §2143.

Under these criteria, the Office Action fails to establish a *prima facie* case of obviousness of claims 1-3, 9, 11, 12 and 15 based on the cited prior art.

Claim 1 includes "a real-time adaptive loop shaping circuit configured to detect vibration energy in a position error signal in real-time, and to responsively adjust, in real-time, at least one parameter of a transfer function of the vibration damping circuit to reduce vibrations at different frequencies." (Emphasis Added).

In the Office Action, the Examiner suggests that elements 120, 122 and 128 of Ottesen reduce vibrations in signals that drive the actuator in a manner similar to the "real-time adaptive loop shaping circuit" of claim 1. However, these elements of Ottesen do not operate in "real-time" to reduce vibrations in signals that drive the actuator. Evidence showing that elements 120, 122 and 128 do not operate in real-time can be found in FIG. 6A of Ottesen. The flow chart of FIG. 6A requires deactivation of all notch filters (step 202) and a reduction of the spindle velocity (step 210) for elements 120, 122 and 128 to carry out necessary computations for vibration detection and reduction. New coefficients, produced as a result of these computations, are incorporated in the notch filters before they are subsequently re-activated for normal operation. Clearly, the deactivation of all vibration filtering elements (notch filters) and the reduction of the spindle velocity cannot be carried out in "real-time" during normal operation of the disc drive. Therefore, the teachings of Ottesen are in contrast with the above limitations of claim 1.

In response to the Appellants' arguments that the elements of Ottesen do not operate in "real-time" to reduce vibrations in signals that drive the accuator, the Examiner

states that in both the Appellants' invention and that taught by Ottesen, the circuits adaptively adjust parameters at the present time instead of during a manufacturing stage. By making this statement, the Examiner appears to suggest that any parameter adjustment that does not occur during a manufacturing stage occurs at the present time (or real-time). However, this is clearly in contrast with the definition of real-time (the actual time in which a physical process under computer study or control occurs) that the Examiner has provided in the Office Action. The definition provided by the Examiner further distinguishes the claimed invention from the cited art. This is because, in Ottesen, the deactivation of all vibration filtering elements (notch filters) and the reduction of the spindle velocity will not allow for the vibration filtering process (the physical process under computer control) to be carried out in real-time (the actual time in which a physical process under computer study or control occurs). Also, the Appellants' admitted prior art (figure 2) does not show the above-noted limitation of claim 1.

Since all the elements of the present invention as claimed by claim 1 are not taught by the cited prior art, the Examiner has failed to support any *prima facie* conclusion of obviousness with regard to claim 1. Furthermore, the Examiner provided no evidentiary basis for modifying the cited references to arrive at the present invention as claimed by claim 1. Thus, independent claim 1 is non-obvious over the cited prior art.

Independent claim 11 has elements similar to that of independent claim 1. Thus, for the same reasons as independent claim 1, Appellants submit that independent claim 11 is allowable as well. Moreover, Appellants respectfully submit that the dependent claims are also allowable by virtue of their dependency, either directly or indirectly from allowable independent claims 1 and 11. Further, the dependent claims set forth numerous elements not shown or suggested in the cited

references (Appellants' admitted prior art (figure 2), Ottesen and Sidman). For example, claim 2 includes "the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter." (Emphasis Added). None of the cited references show this limitation of claim 2.

II. Rejection of Group II claims

Claims 16-19 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Appellants' admitted prior art (figure 2) in view of Ottensen. Further, claim 20 was rejected under 35 U.S.C. §103(a) as being unpatentable over Appellant's admitted prior art (figure 2) and Ottensen, and further in view of Sidman.

Claim 16 is written-in "means-plus-function" form and includes "a real-time adaptive loop shaping means for attenuating disturbances in the servo loop." In examining a means-plus-function claim, the Supplemental Examination Guidelines for Determining the Applicability of 35 U.S.C. § 112, Paragraph 6, which were set forth in the Federal Register on June 21, 2000 (Vol. 65, No. 120) apply. (See also In re Donaldson Co., 29 U.S.P.Q.2d 1845 (Fed. Cir. 1994) and IMS Technology, Inc. v. Haas Automation, Inc., 54 U.S.P.Q.2d 1129 (Fed. Cir. 2000)). Section II, paragraph 2 of the Guidelines, states "If a claim limitation invokes 35 U.S.C. § 112, para 6, it must be interpreted to cover the corresponding structure, material or acts in the specification and 'equivalents thereof'".

In the present case, independent claim 16 recites a real-time adaptive loop shaping means for attenuating disturbances in the servo loop. Thus, according to the Guidelines, the structure (i.e., the real-time adaptive loop shaping means for attenuating disturbances in the servo loop) shall be construed as disclosed in Appellants' Specification. The

corresponding structure can be found at FIG. 3 (for example) and includes a real-time adaptive loop shaping circuit 302 that detects vibration energy in a position error signal in real-time. In response to detecting the vibration energy, circuit 302 adjusts, in real-time, at least one parameter of a transfer, function of a vibration damping circuit 214 to reduce vibrations at different frequencies in a driving energy signal received by the vibration damping circuit 214.

As mentioned above, elements 120, 122 and 128 of Ottesen do not reduce vibrations in signals that drive the actuator in "real-time." This is in contrast with the real-time adaptive loop shaping means (and its corresponding structure) recited in claim 16. Therefore, a properly interpreted means-plus-function claim 16 is non-obvious over the cited prior art.

Appellants respectfully submit that the dependent claims are also allowable by virtue of their dependency, either directly or indirectly from allowable independent claim 16. Further, the dependent claims set forth numerous elements not shown or suggested in the cited references (Appellants' admitted prior art (figure 2), Ottesen and Sidman). For example, claim 18 includes "the <u>real-time</u> adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to <u>responsively</u> adjust a depth of the notch filter." (Emphasis Added). None of the cited references show this limitation of claim 18.

<u>CONCLUSION</u>

For the reasons discussed above, Appellants respectfully submit that claims 1-4, 9, 11-12, 15-20 and 25 are neither taught nor suggested by the references cited by the Examiner. Thus, Appellants respectfully request that the Board reverse the Examiner and find all pending claims allowable.

Respectfully submitted,

WESTMAN, CHAMPLIN & KELLY, P.A.

By: ARego

Alan G. Rego, Reg. No. 45,956
Suite 1600 - International Centre
900 Second Avenue South
Minneapolis, Minnesota 55402-3319
Phone: (612) 334-3222 Fax: (612) 334-3312

AGR:tkj

Appendix A

1. An apparatus comprising:

a vibration damping circuit coupled to receive a driving energy signal; and

a real-time adaptive loop shaping circuit configured to detect vibration energy in a position error signal in real-time, and to responsively adjust, in real-time, at least one parameter of a transfer function of the vibration damping circuit to reduce vibrations at different frequencies in the driving energy signal received by the vibration damping circuit.

2. The apparatus of claim 1 wherein the vibration damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

3. The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.

4. The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.

5.(Pending but not on appeal) The apparatus of claim 1 wherein the vibration damping circuit includes a non-repeatable runout compensator to cancel non-repeatable runout disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error

signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

6.(Pending but not on appeal) The apparatus of claim 5 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.

7.(Pending but not on appeal) The apparatus of claim 1 wherein the vibration damping circuit includes a rotational vibration compensator to cancel rotational vibration disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the rotational vibration compensator.

8.(Pending but not on appeal) The apparatus of claim 7 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect rotational vibration disturbances in the position error signal.

9. The apparatus of claim 1 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.

10.(Pending but not on appeal) The apparatus of claim 1 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.

11. A method of maintaining stability in a servo loop a servo controller, the method comprising:

(a) detecting vibration energy in a position error signal in real-time; and

(b) adjusting, in real-time, at least one parameter of a transfer function of the servo controller to attenuate the vibration energy detected in step (a) at different frequencies.

12. The method of claim 11 wherein the detecting vibration energy step (a) includes detecting vibrations at high frequency resonance modes, and wherein the adjusting step (b) includes adjusting a depth of a notch filter of the servo controller to reduce vibrations at high frequency resonance modes.

13.(Pending but not on appeal) The method of claim 11 wherein the detecting vibration energy step (a) includes detecting non-repeatable runout disturbances, and wherein the adjusting step (b) includes adjusting at least one parameter of a transfer function of a non-repeatable runout compensator of the servo controller to reduce non-repeatable runout disturbances.

14.(Pending but not on appeal) The method of claim 11 wherein the detecting vibration energy step (a) includes detecting rotational vibration disturbances, and wherein the adjusting step (b) includes adjusting at least one parameter of a transfer function of a rotational vibration compensator of the servo controller to reduce rotational vibration disturbances.

15. The method of claim 11 wherein the detecting vibration energy step (a) and the adjusting step (b) is carried out by a real-time adaptive loop shaping circuit.

16. A servo loop comprising:
a servo controller; and
a real-time adaptive loop shaping means for attenuating disturbances in the servo loop.

17. The apparatus of claim 16 wherein~~:~~
the real-time adaptive loop shaping means comprises a real-time adaptive loop shaping circuit adapted to:
detect vibration energy in a position error signal in real-time, and to responsively adjust, in real-time, at least one parameter of a transfer function of a vibration damping circuit of the servo controller to reduce vibrations at different frequencies in the servo loop.

18. The apparatus of claim 17 wherein the vibration damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

19. The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.

20. The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.

21. (Pending but not on appeal) The apparatus of claim 17 wherein the vibration damping circuit includes a non-repeatable runout

compensator to cancel non-repeatable runout disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

22.(Pending but not on appeal) The apparatus of claim 21 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.

23.(Pending but not on appeal) The apparatus of claim 17 wherein the vibration damping circuit includes a rotational vibration compensator to cancel rotational vibration disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the rotational vibration compensator.

24.(Pending but not on appeal) The apparatus of claim 23 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect rotational vibration disturbances in the position error signal.

25. The apparatus of claim 17 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.

26.(Pending but not on appeal)The apparatus of claim 17 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.

Appendix B

Ottesen et al., U.S. Patent No. 6,417,982, July 2002

Sidman et al., U.S. Patent No., 5,155,422, October 1992

Appendix C

In re Vaeck, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

In re Donaldson Co., 29 U.S.P.Q.2d 1845 (Fed. Cir. 1994).

IMS Technology, Inc. v. Haas Automation, Inc., 54 U.S.P.Q.2d 1129 (Fed. Cir. 2000).